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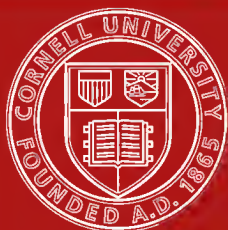
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**IMPERIAL MINERAL RESOURCES
BUREAU.**

**THE MINERAL INDUSTRY OF
THE BRITISH EMPIRE**

AND

FOREIGN COUNTRIES.

WAR PERIOD.

NITRATES.

(1913-1919.)



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PREFACE.

The following digest of statistical and technical information relative to the production and consumption of nitrates will constitute a part of the Annual Volume on the Mineral Resources of the British Empire and Foreign Countries.

In this the first year of publication an effort has been made to fill in, as far as possible, the hiatus due to the war in the publications relating to mining and metallurgical statistics. Labour, health, and safety statistics have been omitted owing to the difficulty involved in procuring reliable information for the war period, but in future issues these statistics will be included in respect of each year.

Resort will also be had, to a much greater extent than at present, to graphical representation of statistics of production, consumption, costs and prices.

R. A. S. REDMAYNE,

Chairman of the Governors.

2, Queen Anne's Gate Buildings,
London, S.W.1.

June, 1920.

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GENERAL.

The two mineral nitrates of economic interest are sodium nitrate (Chile saltpetre) and potassium nitrate (true nitre or saltpetre).

The alkaline nitrates are readily soluble, and are only to be found in large quantities under exceptional circumstances. This solubility accounts for the migration of the salts from the place of formation, and its recrystallization on the walls and in the cavities of rocks.

Sodium nitrate occurs naturally in many parts of the world, but supplies have hitherto been obtained chiefly from the desert region of Tarapaca and Atacama in the northern part of Chile.

Potassium nitrate occurs in the soils of old villages, mixed with nitrates of calcium and magnesium, and sodium chloride, and probably results from the combined action of bacteria and air upon nitrogenous organic compounds. It occurs also as efflorescences and impregnations of various rocks in sheltered cliffs, and in caves.

The chief uses of nitrates are in the manufacture of nitric acid and explosives, and for fertilizer purposes.

Iodine is a by-product obtained in the refining of the nitrate, and at the present time the world's supply is obtained almost entirely from the oficinas of the Chile nitrate industry.

During recent years Chile nitrate has had to compete with artificial nitrates produced by synthetic processes which, when operated on a large scale and under favourable conditions, furnish supplies of nitrate at a sufficiently low cost to compete with mineral nitrate. Prior to the war Germany was the largest consumer of nitrates in the world, and she was also the largest producer of synthetic nitrate. Synthetic nitrate has also been produced to a considerable extent in Norway.

Figures for the production of synthetic nitrates are not available for the period under review, but the output was large, and if it could be maintained it would compete to a serious extent with the production of Chile nitrate. One should remember, however, that the output was effected largely in Germany under abnormal conditions; and it remains to be seen whether the large production which took place under the necessitous conditions of war will be maintained.

PRODUCTION.

The world's chief producers of nitrate, excluding synthetic nitrate, are Chile and India. A considerable amount is produced also in Egypt, but the total output is not known definitely. The figure for Egypt given below is the output of one company only. There has also been a small output in the Sanjak of Konia, Turkey, presumably from nitre earths of the kind worked in India.

The outputs of Chile, India and Egypt for the period under review have been as follows, in metric tons* :—

—	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Egypt (a) .	4,740	3,370	4,271	3,950	4,347		
India (b) .	14,698	15,742	18,394	25,465	21,632	25,145	
Chile (a) .	2,773,552	2,464,421	1,763,639	2,914,542	3,013,517	2,841,198	1,672,374

* The metric ton, long ton, and cwt., referred to at various places in this publication, are equivalent to 2,204 lbs., 2,240 lbs. and 112 lbs. respectively.

(a) Sodium nitrate.

(b) Potassium nitrate.

PRICES.

The most notable event as regards prices during the period took place in 1918, when the purchase and sale of Chilean nitrates was centralized by the Allied Governments and the Government of Chile, the Allies purchasing through a joint purchasing board known as the "Nitrate of Soda Executive" and the Chilean Government acting for the sellers. The price was then fixed at 13s. for ordinary and 13s. 6d. for the refined nitrate, per Spanish quintal of 101.4 lbs., as compared with 7s. 9d. per quintal in 1913

BRITISH EMPIRE.

United Kingdom.

Great Britain produces no nitrates, and is entirely dependent for the natural product on the imports from Chile.

The imports shown in detail in the following tables during the war years apply only to nitrates used as fertilizers. The nitrate used for munition purposes was included by the Board of Customs under "Chemicals unenumerated," the detailed figures for which are unavailable. The imports under this head are entered by value only, the figures relating to Chile being as follows* :—

1913	£197,712	1916	£5,332,524
1914	£209,856	1917	£6,365,716
1915	£1,857,272	1918	£15,268,702
1919	£648,409		

The Bureau is informed by the Ministry of Munitions that the nitrate of soda imports into the United Kingdom during the period 1914-1918 have been as follows :—

Year.	Quantity.	Remarks.
1914	199,000 tons	
1915	285,000 „	
1916	388,000 „	Government account only.
1917	247,000 „	Government account only.
1918	526,000 „	(Including about 55,000 tons on private account.)

The exports from the United Kingdom increased considerably in 1915, when Russia was dependent very largely for supplies on Great Britain. But after that year, with an ever-increasing demand at home, the exports dropped to practically nothing.

The large increase in the imports of saltpetre came entirely from India, giving a great impetus to the industry in that country.

* Annual Statement of the Trade of the United Kingdom.

Imports of Nitrate of Soda to the United Kingdom.

From		Quantity (long tons).							
		1913.	1914.	1915.	1916.	1917.	1918.	1919.	
Belgium	...	628	1,666	—	—	—	—	—	...
Germany	...	2,454	1,469	—	—	—	—	—	...
Norway	...	781	5,545	2,039	11	—	—	—	...
Chile	...	136,340	163,198	129,453	20,807	1,190	300	24,452	...
Other Foreign Countries	...	723	32	22	78	—	—	33	...
Total Foreign Countries	...	140,926	171,910	131,514	20,896	1,190	300	24,485	...
Total British Possessions	...	—	—	6	—	—	—	—	...
Total	...	140,926	171,910	131,520	20,896	1,190	300	24,485	...
Value (£).									
Belgium	...	7,122	17,228	—	—	—	—	—	...
Germany	...	26,472	15,246	—	—	—	—	—	...
Norway	...	8,457	60,733	24,590	227	—	—	—	...
Chile	...	1,439,931	1,627,499	1,472,874	360,339	19,500	6,000	513,410	...
Other Foreign Countries	...	8,687	432	444	1,053	—	—	1,115	...
Total Foreign Countries	...	1,490,669	1,721,138	1,497,908	361,619	19,500	6,000	514,525	...
Total British Possessions	...	—	—	160	—	—	—	—	...
Total	...	1,490,669	1,721,138	1,498,068	361,619	19,500	6,000	514,525	...

United Kingdom Exports of Nitrate of Soda (Foreign Produce).

To	Quantity (long tons).							Value (£).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Channel Islands	179	71	160	47	3	5	5	2,047	774	1,893	663	67	150	119
Mauritius and Dependencies	312	155	813	—	—	—	50	3,426	1,562	8,965	—	—	—	1,060
British West India Islands	713	802	329	1	—	—	8	8,109	8,190	4,122	18	—	—	204
British India	233	193	381	85	—	—	—	3,519	2,166	4,663	1,504	—	—	—
Australia	50	—	—	—	—	—	—	509	—	—	—	—	—	—
Other British Possessions ..	505	483	733	—	—	—	—	5,985	5,289	8,534	—	—	—	17
Total to British Possessions	1,992	1,704	2,416	133	3	5	63	23,595	17,981	28,177	2,185	67	150	1,400
Egypt	100	1,401	4,067	—	—	—	19,906	1,137	15,524	42,482	—	—	—	430,285
Belgium	—	—	—	—	—	—	58,892	—	—	—	—	—	—	1,546,261
Denmark (including Faroe Islands)	—	823	5,117	—	4,839	—	46,424	—	7,937	61,286	—	91,306	—	1,204,587
France	—	—	2,802	—	—	—	8,239	—	—	35,129	—	—	—	195,702
Germany	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Italy	299	—	—	—	—	—	—	3,300	—	—	—	—	—	—
Netherlands	—	—	—	—	—	—	73,779	—	—	—	—	—	—	1,874,868
Portugal	50	905	993	5	—	—	—	559	9,479	10,212	90	18	—	—
Russia	120	4,066	24,397	185	—	—	1,930	1,406	42,258	299,257	2,970	—	—	48,491
Spain	5,716	9,299	10,768	401	—	—	5,347	66,013	99,202	111,871	6,266	—	—	133,897
Sweden	7	—	—	—	—	—	2,950	72	—	—	—	—	—	74,736
French West Indies	1,041	—	—	—	—	—	—	12,310	—	—	—	—	—	—
Canary Islands	747	—	—	—	—	—	—	8,452	—	—	—	—	—	—
Other Foreign Countries ...	594	1,061	2,884	1	—	—	3,254	6,928	11,062	32,151	15	—	—	69,044
Total to Foreign Countries	8,674	17,575	51,028	592	4,839	—	220,721	100,177	185,462	592,388	9,341	91,324	—	5,577,871
TOTAL	10,666	19,279	53,444	725	4,842	5	220,784	123,772	203,443	620,565	11,526	91,391	150	5,579,271

Imports of Saltpetre to the United Kingdom.

From	Quantity (cwt.s.).							Value (£).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
British India...	60,006	95,464	266,392	439,149	396,508	383,689	139,703	56,631	109,145	363,830	807,579	839,191	835,921	276,906
Other British Possessions ...	—	261	20	—	—	—	—	—	484	25	—	—	—	—
Total from British Possessions.	60,006	95,725	266,412	439,149	396,508	383,689	139,703	56,631	109,629	363,855	807,579	839,191	835,921	276,906
Belgium ...	25,469	19,720	—	—	—	—	—	25,023	19,279	—	—	—	—	—
Germany ...	149,975	97,871	—	114	—	—	—	156,682	92,058	—	160	—	—	—
Netherlands ...	248	1,117	—	—	—	—	—	271	1,563	—	—	—	—	—
United States ...	—	1,674	9,949	—	—	—	—	—	3,258	18,817	—	—	—	—
Other Foreign Countries ...	2,182	3,332	219	—	910	—	—	2,359	4,457	294	—	1,838	—	—
Total from Foreign Countries.	177,874	113,714	10,168	114	910	—	—	184,335	120,615	19,111	160	1,838	—	—
Total ...	237,880	209,439	276,580	439,263	397,418	383,689	139,703	240,966	230,244	382,966	807,739	841,029	835,921	276,906

Exports of Saltpetre (Manufactured in the United Kingdom) from the United Kingdom.

To.	Quantity (cwts.).							Value (£).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Australia	5,833	4,582	5,300	1,312	262	22	372	7,676	6,270	10,825	3,337	803	78	1,014
Other British Possessions ...	2,657	2,727	3,807	5,492	1,153	2,169	2,897	3,571	3,534	9,045	14,939	4,102	8,232	9,784
Total British Possessions	8,490	7,309	9,107	6,804	1,415	2,191	3,269	11,247	9,804	19,870	18,276	4,905	8,310	10,798
Denmark (including Faroe Islands).	680	2,399	4,404	801	160	—	286	867	5,212	10,587	2,200	484	—	1,072
Italy	—	—	—	2,373	1,403	400	140	—	—	—	5,798	3,507	1,100	390
Portugal	1,997	1,403	2,426	2,439	257	2,282	1,911	2,536	1,691	5,474	6,265	821	7,220	4,994
United States	4,187	—	—	—	—	—	—	5,712	—	—	—	—	—	—
Argentine Republic	190	204	1,501	2,155	5,261	7,802	827	241	316	3,290	5,424	16,092	23,709	2,699
Brazil	14,776	5,759	1,838	3,266	748	3,416	22,550	20,953	8,548	3,969	8,784	2,321	11,487	68,527
Other Foreign Countries ...	3,598	3,207	165	1,065	691	365	27,750	5,024	4,475	403	1,939	2,206	1,460	62,543
Total Foreign Countries...	25,428	12,972	10,334	12,099	8,520	14,265	53,464	35,333	20,244	23,723	30,410	25,731	44,976	140,225
Total	33,918	20,281	19,441	18,903	9,935	16,456	56,733	46,580	30,048	43,593	48,686	30,636	53,286	151,023

Exports of Saltpetre (Foreign Produce) from the United Kingdom.

To	Quantity (cwts.).							Value (£).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
British West India Islands...	3,000	2,760	—	—	—	—	—	2,664	2,727	—	—	—	—	—
Other British Possessions ...	639	210	31	23	59	—	—	788	269	77	58	206	—	—
Total to British Possessions	3,639	2,970	31	23	59	—	370	3,452	2,996	77	58	206	—	794
France ...	—	96	47,816	26,038	20,133	37,701	18,326	—	114	80,609	44,455	40,377	81,318	37,741
French West India Islands...	5,400	4,294	—	—	—	—	—	4,627	4,119	—	—	—	—	—
United States of America ...	—	—	—	86,164	47,841	18,926	10,365	—	—	—	154,714	96,629	39,357	18,982
Other Foreign Countries ...	1,467	473	4,237	1,889	298	1,500	2,743	1,736	640	8,576	4,889	1,065	3,400	6,021
Total to Foreign Countries	6,867	4,863	52,053	114,091	68,272	58,127	31,434	6,363	4,873	89,185	204,058	138,071	124,075	62,744
Total ...	10,506	7,833	52,084	114,114	68,331	58,127	31,804	9,815	7,869	89,262	204,116	138,277	124,075	63,538

Egypt.*

Nitrate of soda is obtained from the Esna shales in the Qena district.

From the available information, these shales appear to contain about 1 per cent. of nitrate of soda mixed with large quantities of common salt. The dampness causes the salt to effloresce, and the rural population in the vicinity utilize it as a fertilizer in its impure state.

The production shown on p. 6 represents the output of one company only. A considerable amount is collected by numerous cultivators, and no definite information is available as to the total output.

Union of South Africa.

Nitrates have been reported from all the more arid districts of the Union, but upon investigation they have so far proved to be merely cave fillings from the excreta of rock rabbits, bats, and the decomposition of the urine of baboons.

In the districts of Prieska and Hay, nitrates, essentially potassium nitrates, occur at a large number of places within the limits of the ferruginous shales of the Lower Griqua Town Series, usually inclined at low angles, and lying along the basal portion of thicker krantzies, often associated with caves, recesses and other places protected from rain. Nitre is also found as incrustations and irregular pockets or short veins on joint faces, bedding planes, etc., as well as in yellow layers, usually where the strata are more thinly bedded.

Much attention has been given recently to the question of the development of these nitrates of the Prieska district, but the officials of the Union of South Africa Department of Mines take the view that the deposits are not rich enough to make their exploitation on a large scale a commercial success. Small amounts have been obtained at various times for local uses, but no production figures are available.

The Imperial Mineral Resources Bureau has recently (June, 1920) received a report from the Inspector of Mines, Pretoria, in which he states that the efforts lately made to produce nitrates on a large commercial scale from the Prieska shales have proved a failure. Over a hundred tons of rock were treated at Spitzkop for a recovery of about two tons of saltpetre, the cost being excessive and resulting in a large loss. The work initiated at Kloof, thirty-four miles north of Prieska, has been suspended; and, with the exception of a few tanks, all the elaborate and costly plant has been removed. A little undercutting has been done at the base of the cliff, but not to any large extent. Most of the nitre was obtained from the outer twelve inches of crust; and at a depth of four or five feet the yield amounted to only about one pound of saltpetre per ton of rock.

* *Annuaire Statistique de l'Egypte.*

*Imports of Nitrate of Soda to the Union of South Africa.**

	Quantity (lbs.).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.
United Kingdom.	96	—	—	—	—	—	—
Germany ...	89,600	13,376	—	—	—	—	—
Holland ...	11,200	12,000	—	—	—	—	—
Norway ...	—	2,240	—	—	—	—	—
Chile ...	45,600	22,400	—	2,588	—	—	—
Total ...	146,496	50,016	—	2,588	—	—	—

	Value (£).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.
United Kingdom.	1	—	—	—	—	—	—
Germany ...	421	72	—	—	—	—	—
Holland ...	53	41	—	—	—	—	—
Norway ...	—	10	—	—	—	—	—
Chile ...	212	104	—	15	—	—	—
Total ...	687	227	—	15	—	—	—

* Annual Statement of the Trade and Shipping of the Union of South Africa.

Canada.†

Nitre has been found in small quantities as a white granular powder in travertine in the Quesnel Mining Division, British Columbia, and appears to have been formed recently by the decay of organic matter. No production of mineral nitrates is reported from this or other localities in Canada.

† Statistics from the Annual Report of the Trade and Commerce of Canada.

Canadian Imports of Nitrate of Soda (for fiscal years ending March 31).

		Quantity (lbs.).							
		1913.	1914.	1915.	1916.	1917.	1918.	1919.	
United Kingdom...	...	987,470	480,966	337,384	—	—	—	—	
Belgium ...	...	—	37,609	80,000	—	—	—	—
France ...	...	63,775	26,331	11,200	—	—	—	—
Germany ...	...	404,581	229,774	101,496	—	—	—	—
Netherlands ...	...	—	—	—	—	—	—	—
Norway ...	...	—	11,193	6,515	—	—	—	—
United States ...	...	42,219,119	35,898,258	26,022,921	53,314,476	77,821,375	51,089,362	—
Chile ...	...	43,880,960	43,578,050	—	7,014,586	6,379,652	11,414,638	—
		87,555,905	80,262,181	26,559,516	60,329,062	84,201,027	62,504,000	—	
		Value (\$).							
United Kingdom...	...	24,906	12,719	8,790	—	—	—	—	
Belgium ...	...	—	2,023	1,879	—	—	—	—
France ...	...	2,141	1,005	389	—	—	—	—
Germany ...	...	15,371	8,568	3,836	—	—	—	—
Netherlands ...	...	—	—	—	—	—	—	—
Norway ...	...	—	519	286	—	—	—	—
United States ...	...	975,102	826,277	566,219	1,423,607	2,399,425	2,332,807	—
Chile ...	...	624,964	767,265	—	146,986	134,153	309,383	—
		1,642,484	1,618,376	581,399	1,570,593	2,533,578	2,642,190	—	

Canadian Imports of Saltpetre (fiscal years ending March 31).

	Quantity (lbs.).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.
U.K. ...	77,564	146,611	6,800	329,473	186,037	12,216	
Hong Kong	—	—	260	326	—	—	
France ...	5,600	—	—	—	—	—	
Germany ...	688,325	560,700	99,305	—	—	—	
U.S.A. ...	1,066,822	1,002,317	2,173,407	1,543,797	424,048	924,619	
China ...	650	—	—	—	—	—	
	1,838,961	1,709,628	2,279,772	1,873,596	610,085	936,835	
	Value (\$).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.
U.K. ...	3,922	7,610	428	35,911	24,376	2,045	
Hong Kong	—	—	9	7	—	—	
France ...	246	—	—	—	—	—	
Germany ...	32,148	25,708	5,157	—	—	—	
U.S.A. ...	52,025	51,556	134,637	228,505	66,498	183,770	
China ...	7	—	—	—	—	—	
	88,348	84,874	140,231	264,423	90,874	185,815	

India.*

Potassium nitrate has been produced in India from very early times. For long the trade was a monopoly of the East India Company who were under an obligation to supply the British Government before other consumers. The trade has always been subject to extreme fluctuations, the trend of political events having a direct effect on it. It attained its highest values from 1860 to 1864, at the time of the American Civil War, for at that period saltpetre was an essential constituent of explosives, and India had practically a monopoly of supplies. The average annual exports then amounted to over 30,000 tons, but the development of the South American nitrate industry caused the Indian trade gradually to decline and exports had fallen to 13,000 or 14,000 tons per annum, in the years immediately preceding the war. The war period witnessed the usual stimulation of the trade.

The most important centre of production is the Bihar section of the Gangetic plain. Here, an agricultural population of over 500 per square mile supplies an abundance of organic nitrogen, the climatic conditions are ideal for the growth of the so-called "nitrifying bacteria," the soil around the villages is well-stocked

* Records of the Geological Survey of India, Annual Statement of the Seaborne Trade of British India. Accounts relating to the Seaborne Trade and Navigation of British India.

with potash from the universal use of wood and cow dung for fuel, and the continuous surface desiccation following a small rainfall, causes the subsoil water to bring to the surface an efflorescence of salts in which potassium nitrate is conspicuous. Saltpetre is also extracted in the United Provinces and in the Punjab, while small amounts are imported from Nepal every year.

The system of manufacture has been described repeatedly. It consists in dissolving out the mixed salts from the surface soil collected around the villages, and in effecting a rough separation of the sodium chloride and potassium nitrate. The latter is sent to refineries for purification before export.

The manufacture is controlled under licences issued by the Northern India Salt Revenue Department and the first portion of the work is done by a special caste which carries on the operations as an hereditary profession.

The crude nitrate earths contain on an average about 3 per cent. to 5 per cent. of saltpetre. The crude product of the Bihar and United Provinces yields 40 per cent. to 50 per cent. refined saltpetre, the Punjab crude about 30 per cent.

Of especial interest and importance are the various suggestions which have been made in recent years with a view to increasing the sources of supply and improving the methods of production. (See references to technical literature, pages 25-28.)

Production of Saltpetre in India.

Year.			Quantity (long tons).	Value. £
1913	...	...	14,462	200,803
1914	...	...	15,489	272,462
1915	...	...	18,098	373,891
1916	...	...	25,056	607,488
1917	...	...	21,284	527,666
1918	...	...	24,741	589,190
1919	...	...

Imports of Saltpetre to India (fiscal years ending March 31).

From	Quantity (cwts.).					
	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.
Total British Empire.	527	160	222	140	18	1
Total Foreign Countries.	21	11	—	—	—	—
Total ...	548	171	222	140	18	1
	Value (£).					
	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.
Total British Empire.	345	144	99	213	85	9
Total Foreign Countries.	31	15	—	—	—	—
Total ...	376	159	99	213	85	9

*Imports of Saltpetre from Nepal (fiscal years ending March 31).**

Year.	Quantity cwts.	Value £
1914-15	822	457
1915-16	4,890	3,793
1916-17	5,970	3,975
1917-18	5,444	4,037
1918-19	5,683	4,553

*Annual Reports on the Trans-frontier Trade of Bihar and Orissa with Nepal, taking 1 maund = 82.25 lb., and 15 rupees = £1. Small quantities of saltpetre are also exported to Nepal.

Exports of Saltpetre from India.

To	Quantity (cwts.).							Value (£).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
United Kingdom ...	56,430	127,936	296,106	428,099	478,194	337,828	133,898	44,651	112,924	315,372	559,154	629,675	445,825	157,250
Ceylon ...	43,813	44,085	57,221	18	1,051	—	59,749	30,177	28,674	45,393	29	1,398	—	50,696
Mauritius and Dependencies	38,200	23,406	15,146	—	11,095	—	39,534	27,714	17,778	13,408	—	14,453	—	38,975
France... ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—
China ...	80,574	49,266	31,692	—	—	—	—	65,277	40,305	27,335	—	—	—	—
Japan ...	—	—	7,642	32,054	8,037	11,968	10,145	—	—	8,801	47,127	9,590	14,775	13,822
United States of America ...	50,920	19,163	—	19,984	3,000	110,067	25,896	40,149	15,096	—	25,230	3,966	141,947	25,965
Other Countries ...	34,755	21,300	10,761	4,826	14,997	8,717	75,192	29,613	19,987	12,075	6,584	20,141	11,908	82,676
Total	304,692	285,156	418,608	484,981	516,374	468,580	344,414	237,581	234,764	422,384	638,124	679,223	614,455	369,384

*Exports of Potassium compounds (other sorts) from India.
(Domestic produce). Fiscal years ending March 31.*

Year.	Quantity. cwts.	Value. £
1913-14	—	—
1914-15	(a) 1,308	872
1915-16	—	—
1916-17	2	4
1917-18	(b) 15,781	81,633
1918-19	16,555	100,534

(a) Exported to Ceylon.

(b) Chiefly to the United States of America.

Australia.*

No production of mineral nitrates is reported from Australia.

*Imports of Sodium Nitrate to Australia (fiscal years ending
June 30).*

From	Quantity (cwts.).				
	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.
U.K.	1,500	—	32	—	
Chile	65,708	112,203	165,434	53,800	
Other Countries	300	—	6	—	
Total	67,508	112,203	165,472	53,800	
Value (£).					
U.K.	885	—	46	—	
Chile	32,966	49,463	107,926	43,264	
Other Countries... ..	208	—	5	—	
Total	34,059	49,463	107,977	43,264	

*Exports of Sodium Nitrate (Foreign Produce) from Australia
(fiscal years ending June 30).*

To	Quantity (cwts.).				
	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.
New Zealand	742	611	2,972	4,479	
Fiji	558	8	4,367	14,409	
Japan	—	2,000	—	—	
Total	1,300	2,619	7,339	18,888	
Value (£).					
New Zealand	407	428	2,286	5,395	
Fiji	370	7	3,392	11,346	
Japan	—	1,400	—	—	
Total	777	1,835	5,678	16,741	

* Trade and Customs and Excise Revenue of the Commonwealth of Australia.

Australian Imports of Saltpetre (fiscal years ending June 30).

From.	Quantity (cwts.).				
	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.
U.K.	3,790	3,451	997	87	
Canada	—	—	61	—	
India	1,779	3,435	2,073	4,933	
New Zealand	284	—	—	—	
U.S.A.	729	636	250	906	
Other Foreign Countries	918	—	40	—	
Total	7,500	7,522	3,421	5,926	
Value (£).					
U.K.	7,131	7,470	2,671	355	
Canada	—	—	163	—	
India	2,505	5,628	3,673	10,580	
New Zealand	284	—	—	—	
U.S.A.	1,084	756	271	1,448	
Other Foreign Countries	926	—	34	—	
Total	11,930	13,854	6,812	12,383	

*Australian Exports of Saltpetre (Foreign Produce)
(fiscal years ending June 30).*

To	Quantity (cwts.).				
	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.
New Zealand	—	155	—	780	
Other British Possessions	55	7	56	13	
Pacific Islands (Foreign)	—	15	—	13	
Other foreign countries ...	10	—	21	—	
Total	65	177	77	806	
Value (£).					
New Zealand	—	362	—	1,361	
Other British Possessions	76	20	89	43	
Pacific Islands (Foreign)	—	33	—	27	
Other foreign countries ...	14	—	47	—	
Total	90	415	136	1,431	

FOREIGN COUNTRIES.

Chile.*

The principal source of the world's supply of mineral nitrate is in the form of sodium nitrate, which is found in large quantities in Chile. The nitrate industry forms the principal source of income for the Government of Chile. The annual value of the industry is about \$138,000,000 and the revenue to the Government \$35,000,000.

The nitrate deposits in Chile lie principally in the Atacama and Tarapaça deserts, some 3,500 to 13,000 feet in altitude. The nitrate is shipped from the seaports of Valparaiso, Iquique, Pisagua, Patillos and Antofagasta, all of which places have connection by narrow-gauge railways with the nitrate fields. The bed is superficial in formation and of considerable though irregular extent.

The raw nitrate of soda (caliche) is found in beds 6 inches to 6 feet in thickness, lying beneath an overburden of a few feet of loose and crumbly material and gravel, which gets harder as it reaches the caliche. It is a sandy gravel, cemented with salts, and averages about 25 per cent. of sodium nitrate. In its pure state it is a white or colourless salt, but in nature it is usually found to be a reddish-brown or bright lemon-yellow.

The northern portion of the field lies only about 13 miles from the coast, but the southern fields are 30 miles inland.

In many places the ground water is close enough to the surface to support plant life, and in a few localities adjoining nitrate fields there are some coarse grasses and low shrubs. Generally, however, the nitrate fields show no trace of vegetation of any kind. In part this is due to the salt in the soil, and not entirely to the absence of rainfall.

Most of the nitrate fields are in the tropics, and, in consequence, high temperatures prevail during the day, but, owing to the elevation and the low humidity, the nights are cool, and in winter freezing temperatures are experienced. The altitude, freedom from rain, and yet almost nightly fog and mist, appear to have some connection with the deposits, most of which occur associated largely with sodium chloride (common salt) or as a mixture of this salt and nitre.

The methods adopted for refining the Chile saltpetre generally differ very little from those employed thirty years ago. The raw material, after passing through the crushers, is lifted to the boiling tanks and leached in stages, usually four or five operations being necessary. The whole operation takes 18 to 20 hours per tank. The strong liquor (caldo) is then run into the settling tanks and clarified and the clear liquor decanted off into open troughs

* Final Report of the Nitrogen Products Committee (United Kingdom). Bulletin of the Pan-American Union (Monthly). Asociación Salitrera de Propaganda (Valparaiso) *via* The International Movement of Fertilisers and Chemical Products Useful to Agriculture (Rome).

through which it is conducted to the crystallizing tanks. The crystalline deposit in the tanks is equal to about 25 to 35 lbs. nitrate from 1 cubic foot of caldo.

The mother liquors obtained in refining used to be thrown away, but are now being utilized for the extraction of iodine.

The increased demand for nitrates for fertilizers all over the world, and the great possibilities of production by synthetic means, brings into prominence two important aspects of the Chile nitrate industry, viz. : (1) the permanence of the deposits, and (2) the cost of production under pre-war conditions and the probable cost of production under post-war conditions, together with the cost of placing the product on the European market.

It has been stated that the Chilean nitrate deposits are nearly exhausted, but according to the Chilean Nitrate Committee's Report, this is not the case. According to that report the quantity of nitrate of soda in the examined ground was estimated at 245,300,000 tons, and "these statements therefore conclusively show that there is no fear of the Chilean nitrate deposits being exhausted for 200 years."

The cost of production of nitrate (95 per cent. purity containing 15.65 per cent. nitrogen) prior to the war was £5 10s. per long ton. Sea freight at 25s. and insurance 2s. 6d. per ton added £1 7s. 6d., while loss in weight came to 15s., and Chilean export duty at 2s. 4d. per quintal added £2 11s. 4d. per long ton. Thus the total pre-war cost on shore in England or on the Continent was £10 3s. 10d. per long ton. The pre-war market price (average 1911-1913) was £10 13s. 9d. During the war the selling price of Chile nitrate rose to £12 12s. 11d. per long ton in 1915, and £17 12s. 6d. in 1916.

By the introduction of improved methods it is believed (Nitrogen Products Committee) that a reduction of 25 per cent. may be brought about in the average cost per quintal of nitrate of soda on the drying floor; and, in the event of severe competition to the industry by the synthetic processes, the Chilean Government may be induced to reduce the export duties and property charges rather than lose the market. The Committee referred to above gives the greatest reduction that seems possible in the costs of production of Chile nitrate as follows :—

	Saving per long ton of nitrate.		
Chilian duty reduced to 10s. per ton	2	1	4
Cost of extraction reduced by 25 per cent. (9d. p. quintal)	0	16	6
Freight reduced to 20s. per ton	0	5	0
Total	£3	2	10

Production of Nitrate in Chile.

Year.						Quantity (metric tons).
1913	...	...	...	...	...	2,773,552
1914	...	...	...	...	...	2,464,427
1915	...	...	...	...	...	1,763,639
1916	...	...	...	...	...	2,914,542
1917	...	...	...	...	...	3,013,517
1918	...	...	...	...	...	2,841,198
1919	...	...	...	...	...	1,672,374

Chilian Exports of Sodium Nitrate.

To	Quantity (Metric tons).						
	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Total Europe (in- cluding United Kingdom).	2,008,010	1,198,317	999,749	1,609,381	1,053,786		
United States ...	630,698	540,143	850,928	1,226,816	1,512,577		
Other Countries...	100,822	109,076	180,297	149,103	202,699		
Total ...	2,739,530	1,847,536	2,030,974	2,985,300	2,769,062	2,932,849	933,686

REFERENCES TO TECHNICAL LITERATURE.

International Institute of Agriculture, Rome; Bulletin of Statistics; International Movement of Agricultural Fertilisers. Nos. 1-9; 1914-1918. (Statistics and Bibliography in each number.)
Asociación Salitrera de Propaganda; Circular Trimestral (Santiago de Chile), Nos. 56 et 83. (1913-1919.)

1913.

Manufacture of nitrates from the atmosphere, by E. K. Scott; Annual Report of the Smithsonian Institution, 1913, 359-384.
Note sur l'industrie minière en Egypte rédigée par le Département des Mines; Annuaire Statistique de l'Egypte, 1913, 5, 579-586.

1914.

Nitre near Melrose, Montana, by R. W. Richards; U.S. Geol. Surv. Bull. No. 540, 1914, 470-473.
Our mineral reserves, by G. O. Smith; U.S. Geol. Surv. Bull. No. 599, 1914, 36.
Use of Nitrates in the glass industry, by L. Springer; Sprechsaal, 1914, 47, 361-363. Abstr. Journ. Soc. Chem. Ind., 1914, 33, 693.
The Chilean nitrate industry, by L. W. Strauss; Min. Sci. Press, 1914, 108, 972-978, 1014-1019, 1049-1052.

1915.

The nitrate industry, by E. Cuevas; Proc. Second Pan-Amer. Sci. Congress, 1917, 8, 37-68.
Exploracion de los terrenos salitreros en Territorio Poruano, por J. M. Guzman; Bol. Soc. Nac. Min. Chile, 1915, 21-41.
Experiments on ammonia, by F. Haber, S. Tamarn and L. W. Oeholm; Zeits. f. Elektrochemie, 1915, 21, 89-245.
The nitrate shales of Egypt, by W. F. Hume; Mém. Inst. Egyptien, 1915, 8.
Investigation of sources of potash in Texas, by W. B. Phillips; Trans. Amer. Inst. Min. Eng., 1915, 51, 438-450.
Production of nitrates from air, by E. K. Scott; Journ. Soc. Chem. Ind., 1915, 34, 113-126.
Fixation of atmospheric nitrogen, by L. L. Summers; Trans. Amer. Electrochem. Soc., 1915, 27, 339-383.
The cyanamide process, by F. S. Washburn; Trans. Amer. Electrochem. Soc., 1915, 27, 385-407.
Chilean nitrate industry; U.S. Comm. Rept., 1915, No. 176, July 29. No. 303, Dec. 28. Abstr. Journ. Soc. Chem. Ind., 1915, 34, 870, 1916, 35, 304.

1916.

Conditions affecting the establishment of the nitrate industry in the United States, by L. Addicks; Journ. Ind. Eng. Chem., 1916, 8, 1048.
La substitution grandissante des nitrates artificiels aux nitrates naturels et la captation de l'azote atmosphérique, par D. Bellet; Journ. des Economistes, 1916, 75, 238-245.
Extension, riqueza y duración augurada a los yacimientos salitreros de Chile, por A. Bertrand; Asoc. Salit. de Prop. Circ. Trim, 1916, 70, 22-27.
Mineral studies: the genesis and geology of nitre deposits, by P. N. Chirvinsky; Izvestiya Polytechn. Inst. Novoherkassk, 1916, 5, 36-64, (In Russian, French résumé). See Mineralog. Abstr., 1920, 1, 13.

- Sources of nitrogen compounds in the United States, by G. C. Gilbert; Smithsonian Institution; Publication No. 2421, Washington, 1916, pp. 12.
- Sodium nitrate: a new industry, by D. F. Irvin; Min. Sci. Press, 1916, **113**, 774-776.
- Nitrate deposits in Southern Idaho and Eastern Oregon, by G. R. Mansfield; U.S. Geol. Surv. Bull. No. 620, 1916, 19-44.
- The genesis of the Chilean nitrate deposits, by J. T. Singewald and B. L. Miller; Econ. Geol., 1916, **11**, 103-114, 1917, **12**, 89-96.
- Chilean nitrate industry; U.S. Comm. Rept., March 6, 1916. Abstr. Journ. Soc. Chem. Ind., 1916, **35**, 467.

1917.

- Bibliography of the production of synthetic nitric acid and synthetic ammonia, by J. C. Boyce; Met. and Chem. Eng., 1917, **17**, 328-337.
- The fixation of nitrogen, by J. E. Bucher; Journ. Ind. Eng. Chem., 1917, **9**, 233-253.
- Potash salts in India suitable for chemical manufactures, by L. L. Fermor; Indian Munitions Board Handbook, 1917, 83-84.
- Origin of nitrates in cliffs and ledges, by H. S. Gale; Min. Sci. Press, 1917, **115**, 676-678.
- Nitrates, by H. S. Gale; U.S. Geol. Surv. Bull. No. 666Z, 1917, pp. 4.
- Production of nitrate of soda in Chile, by I. Hobsbaum and J. L. Grigioni; Journ. Soc. Chem. Ind., 1917, **36**, 52-62 (Discussion), 62-63.
- Literature of the nitrogen industries, 1912-1916, by H. R. Hosmer; Journ. Ind. Eng. Chem., 1917, **9**, 424-438.
- Saltpetre: its origin and extraction in India, by C. M. Hutchinson; Bull. Agric. Research Inst., 1917, **68**, pp. 24. Abstr. Journ. Soc. Chem. Ind., 1917, **36**, 709.
- "Caliche" deposits of Atacama Desert, Chile, by F. MacCoy; Eng. and Min. Journ., 1917, **103**, 1059-1060.
- The synthesis of ammonia and the oxidation of ammonia to nitric acid by E. B. Maxted; Journ. Soc. Chem. Ind., 1917, **36**, 777-782.
- Manufacture of synthetic nitrates by electric power, by E. K. Scott; Journ. Soc. Chem. Ind., 1917, **36**, 771-777.

1918.

- Norwegian manufacture of saltpetre and artificial fertilizer, by H. E. Carlson; U.S. Comm. Rept., Dec. 7, 1918.
- Modern mill appliances in nitrate leaching, by D. F. Irvin; Eng. Min. Journ., 1918, **105**, 987-991.
- The war and the nitrogen industry, by W. S. Landis; Trans. Amer. Electrochem. Soc., 1918, **34**.
- Studies in nitride formation, E. B. Maxted; Journ. Soc. Chem. Ind., 1918, **37**, 105-109T.
- The synthesis of ammonia at high temperatures, by E. B. Maxted; Journ. Chem. Soc., 1918, **113**, 158, 386; 1919, **115**, 113-119. Abstr. in Journ. Soc. Chem. Ind., 1918, **37**, 368A; 1919, **38**, 219A.
- Notes on the catalytic and thermal synthesis of ammonia, by E. B. Maxted; Journ. Soc. Chem. Ind., 1918, **37**, 232-235T.
- The Chilean nitrate industry, by A. H. Rogers and H. R. Van Wagenen; Trans. Amer. Inst. Min. Eng., 1918, **59**, 6-23 (Discussion) 23-26.
- Direct and indirect methods of nitrogen fixation, by E. K. Scott; Chem. and Met. Eng., 1918, **19**, 411-414.
- Nitrogen fixation furnaces, by E. K. Scott; Chem. and Met. Eng., 1918, **19**, 710-715, 757-761.
- Nitrate deposits of South-Eastern Oregon, by J. A. Williams; Min. Sci. Press, 1918, **117**, 274, 285-289.
- Proposed Japanese-Chilean nitrate enterprise; Board of Tr. Journ., 1918, **101**, 191. Note Journ. Soc. Chem. Ind., 1918, **37**, 329R.

1919.

- Technical utilisation of atmospheric nitrogen by means of the electric flame arc, by H. Andriessens; *Zeit. Elektrochem.*, 1919, **25**, 255-264, Abstr. *Journ. Soc. Chem. Ind.*, 1919, **38**, 814A.
- Effect of diminution of pressure on fixation of nitrogen as nitric oxide by the electric arc, by E. Briner and P. Naville; *Helvetica Chim. Acta.*, 1919, **2**, 348-352. Abstr. *Journ. Soc. Chem. Ind.*, 1919, **38**, 814A.
- A New Potash Supply (potassium nitrate as source in S. Africa), by E. G. Bryant; *Journ. Soc. Chem. Ind.*, 1919, **38**, 360T-362T.
- War-time production of nitrogen compounds in Germany, by Bueb; *Journ. Gasbeleuchtung*, 1919, **62**, 2-3. Abstr. *Journ. Soc. Chem. Ind.*, 1919, **38**, 219A-220A.
- Note on the saltpetre industry in India, by J. F. Connolly; *Indian Industrial Comm.*, 1916-18 (1919), **5**, 772-776.
- How the nitrogen problem has been solved, by H. J. Creighton; *Journ. Franklin Inst.*, 1919, **187**, 705, 733.
- Saltpetre manufacture in India, by J. C. Fergusson; *India Mun. Board Industrial Handbook*, 1919, 369-375.
- The nitrate occurrences in the district of Prieska and Hay, Cape Province, by G. E. B. Frood and A. L. Hall; *Union of S. Africa, Geol. Surv. Mem. No. 14*, 1919, p. 51.
- The Chilean nitrate industry during 1918, by D. F. Irvin; *Eng. Min. Journ.*, 1919, **107**, 265-267.
- Nitrogen-fixation in Europe during the War, by J. W. Joyes; *Chem. and Met. Eng.*, 1919, **21**, 612-613.
- Oxidation of ammonia, by W. S. Landis; *Chem. and Met. Eng.*, 1919, **20**, 470-477. Abstr. *Journ. Soc. Chem. Ind.*, 1919, **38**, 410A.
- Synthesis of ammonia, by E. B. Maxted; *Chem. Age*, 1919, **1**, 514-515, 540-542, 590-592. Abstr. in *Journ. Soc. Chem. Ind.*, 1919, **38**, 944A.
- The mineral deposits of South America, by B. L. Miller and J. T. Singewald, London, 1919 (includes a useful bibliography of Chilean nitrate deposits, pp. 325-347).
- Commercial oxidation of ammonia to nitric acid, by C. L. Parsons; *Journ. Ind. Eng. Chem.*, 1919, **11**, 541.
- Nitric acid and other inorganic chemicals, by M. Rindl; *S. African Journ. Ind.*, 1919, **2**, 327-334.
- Use of ammonium nitrate as a fertiliser, by E. J. Russell; *Journ. Board Agric.*, 1919, **25**, 1331-1339. Abstr. *Journ. Soc. Chem. Ind.*, 1919, **38**, 228A.
- Costs and efficiencies of nitric and sulphuric acid production; *Journ. Soc. Chem. Ind.*, 1919, **38**, 224R-226R.
- Nitrogen fixation in Germany; *Zeit. angew. Chem.*, 1919; *Rev. Journ. Soc. Chem. Ind.*, 1919, **38**, 189R.
- Nitrogen fixation (Review of the American Fixed Nitrogen Commission's work). *Min. Journ.*, 1919, **127**, 741-742.
- Saltpetre; *Rept. Indian Industrial Comm.*, 1916-18 (1919), 372-379.

1920.

- Nitrate industry in Chile, by A. Bertrand; *Chem. Met. Eng.*, 1920, **22**, 655-659.
- Sur la synthèse de l'ammoniac aux pressions très élevées, par G. Claude; *Comptes Rendus Acad. Sci.*, 1919, **169**, 1039-1041; 1920, **170**, 174-177. Abstr. *Journ. Soc. Chem. Ind.*, 1920, **39**, 187Q.
- Political and commercial control of the nitrogen resources of the world, by C. G. Gilbert; *Chem. Met. Eng.*, 1920, **22**, 443-447, 501-504, 557-559.
- Catalytic oxidation of ammonia, by B. Neumann and H. Rose; *Zeits. f. angew. Chem.*, 1920, **33**, 41-44 45-48, 51-55. Abstr. *Journ. Soc. Chem. Ind.*, 1920, **39**, 264-265A.

- The commercial oxidation of ammonia, by G. A. Perley; Journ. Ind. Eng. Chem., 1920, **12**, 5-16, 119-129.
- Artificial nitrogenous fertilisers, by E. J. Russell; Journ. Soc. Chem. Ind., 1920, **39**, 5R-6R.
- The demand and supply of fixed inorganic nitrogen in the United States, by A. H. White; Chem. Met. Eng., 1920, **22**, 369-371.
- Ministry of Munitions of War: Munitions Inventions Department. Nitrogen products Committee: Final Report, London, S. O., 1920. pp. 6, 357. (Cmd. 483.) (Contains a classified list of references to official reports and technical papers on pp. 325-326.)
- The manufacture of nitrate of lime in Norway; Amer. Fert., 1920, **52**, 76.
-

